(BSP February 20, 2002)

Monotube Sign Structures

Bolted Connections

All bolted connections shall be made using the direct tension indicator method, except as otherwise specified.

The Contractor may use tension control bolts at all monotube splice locations, subject to the following conditions:

1. The tension control bolts shall incorporate a design feature intended to either indirectly indicate, or to automatically provide, the bolt tension as specified in Table 3 of Section 6-03.3(33).

2. The Contractor shall submit the tension control bolt system to the Engineer for approval, including but not limited to bolt capacities, type of bolt, nut, and washer lubricant, method of packaging and protection of the lubricated bolt, installation equipment, calibration equipment, and installation procedures.

3. Verification testing of the tension control bolt system shall be performed at the job site in a device capable of indicating the actual bolt tension. A representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade, used for structure assembly shall be tested. The test assembly shall include the type of washers specified for the structure, and the bolt, nut, and washers shall be arranged in the device as specified in the Plans for the structure. The test assembly shall use the lubricated bolts as supplied by the manufacturer.

4. The verification testing shall demonstrate that each bolt develops a tension not less than the tension specified in Table 3 of Section 6-03.3(33).

5. The tension control bolt manufacturer's installation procedure shall be followed for installation of bolts in the verification testing device, in all calibration devices, and in all structure connections.

6. Upon receiving the Engineer's approval of the verification testing results, the Contractor shall assemble the bolts in the splice locations as follows:

    a. All bolts, nuts, and washers shall be lubricated as supplied by the manufacturer and as tested during verification testing.

    b. All bolts shall be initially tightened sufficiently to bring all plies of the splice joint into firm contact but without yielding or fracturing the tension control or tension indicator element of the bolts.

c. All bolts shall be tightened further, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened bolts. In some cases, proper tensioning of the bolts may require more than one cycle of systematic partial tightening prior to final yield or fracture of the tension control or tension indicator element of each bolt.

d. If yield or fracture of the tension control or tension indicator element of a bolt occurs prior to the final tightening cycle, that bolt shall be replaced with a new one.

7. Additional field verification testing shall be performed as requested by the Engineer.

8. All bolts and connecting hardware shall be stored and handled in a manner to prevent corrosion and loss of lubricant. Bolts which are installed without the same lubricant coating as tested under the verification test will be rejected, shall be removed from the joint, and shall be replaced with new lubricated bolts at no additional cost to the Contracting Agency.

Shop Assembly

Prior to galvanizing, the Contractor shall shop assemble the completed structure lying on its side in an undeflected position to ensure correct alignment, accuracy of holes, fit of joints, smooth camber profile, and the specified amount of camber. The joints shall be bolted with a sufficient number of bolts tightened snug tight to close the joints as they would be in the final field assembled position. The Contractor shall not disassemble the sign structure for galvanizing as specified until receiving the Engineer's approval of the shop assembled structure.

Zinc Coating and Painting

All galvanized surfaces exposed to view after erection shall be painted in accordance with Section 6-07.3(4). Contact surfaces of the field bolted connections shall be left unpainted. The paint shall be applied in the field, except as otherwise specified. The Contractor may apply the paint in the shop subject to the Engineer’s prior approval, and provided that all surface areas with damaged paint or exposed metal following erection shall be repaired as specified below.

The color of the finish coat of paint shall match color No. 35237 Federal Standard 595B latest edition when dry.

All galvanized surfaces specified to be painted shall be prepared for painting in accordance with the ASTM D 2092. The method of preparation shall be as agreed upon by the paint manufacturer and the galvanizer. The Contractor shall not begin painting the sign structure until receiving the Engineer’s approval of the prepared galvanized surface.

Damaged galvanized surfaces in the field shall be repaired by the Contractor at the Contractor's expense by painting with one coat of either Formula A-9-73 or Formula A-11-99, followed by field painting with the final two coats specified in Section 6-07.3(4).

Field Assembling

The Contractor shall furnish and install the vibration damper as shown in the Plans. The damper shall be installed before the sign structure is erected.

Welding Inspector Qualification

The fabricator shop will provide a Certified Welding Inspector. The inspector shall be a AWS Certified Welding Inspector (CWI) qualified and certified in accordance with the provisions of AWS QCI Standard for Qualification and Certification.

Welding Inspection

Welds for monotube sign structures shall be inspected using the methods described below.

1. Visual Inspection
   All welds shall have 100 percent of their length visually inspected.

2. Magnetic Particle Inspection
   Fillet welds, and longitudinal butt joint welds in beams, shall have 30 percent of their length inspected using magnetic-particle testing techniques. If rejectable flaws are found in any test length of the weld, the full length of the weld or five feet on either side of the test length, whichever is less, shall be tested.

3. Ultrasonic Inspection
   Groove welds, except the post to beam connection weld and longitudinal butt joint welds in beams, shall have 100 percent of their length inspected using ultrasonic testing techniques. The testing procedure and acceptance criteria for tubular members shall conform to the latest edition of the AWS Structural Welding Code D1.1-Steel.

4. Dye-Penetrant or Magnetic Particle Inspection
   The post to beam connection weld shall have 100 percent of its length inspected using dye-penetrant or magnetic-particle testing techniques. The inspection shall be performed after the root pass and after completion of the weld.